

	= Actual installed
EFLH _{heat}	= heating mode equivalent full load hours; see table above for default values.
EERbase	= Energy Efficiency Ratio of the baseline equipment; see the table above for values. Since IECC 2006 does not provide EER requirements for air-cooled heat pumps < 65 kBtu/h, assume the following conversion from SEER to EER: EER≈SEER/1.1.
EERee	= Energy Efficiency Ratio of the energy efficient equipment. For air-cooled air conditioners < 65 kBtu/h, if the actual EERee is unknown, assume the following conversion from SEER to EER: EER≈SEER/1.1.
	= Actual installed
kBtu/h _{heat}	= capacity of the heating equipment in kBtu per hour.
	= Actual installed
3.412	= Btu per Wh.
COPbase	= coefficient of performance of the baseline equipment; see table above for values.
COPee	= coefficient of performance of the energy efficient equipment.
	= Actual installed

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kW = (\text{kBtu/h}_{\text{cool}}) * [(1/\text{EERbase}) - (1/\text{EERee})] * \text{CF}$$

CF_{SSP} = Summer System Peak Coincidence Factor for Commercial cooling (during system peak hour)
= 91.3%

CF_{PJM} = PJM Summer Peak Coincidence Factor for Commercial cooling (average during peak period)

NATURAL GAS ENERGY SAVINGS

ADM estimated energy savings according to the Errata Corrected Illinois TRM Version 3.0, Section 4.4.10 High Efficiency Boiler.

$$\Delta Therm = \frac{EFLH * Capacity * \left(\frac{Eff_{efficient} - EFF_{base}}{Eff_{base}} \right)}{100,000}$$

Where:

EFLH = Equivalent Full Load Hours for heating (see table)
Capacity = Nominal Heating Capacity Boiler Size (btuh)
= custom Boiler input capacity in Btu/hr

EFFefficient = Baseline Boiler Efficiency Rating, dependent on year and boiler type. Baseline efficiency values by boiler type and capacity are found in the Definition of Baseline Equipment Section

EFFbase = Efficient Boiler Efficiency Rating use actual value

For the water heater, Section 4.3.1 (Version 2.0) Storage Water Heater was used.

NATURAL GAS ENERGY SAVINGS

Gas, High Efficiency	Gas, Standard																														
The annual natural gas energy savings from this measure is a deemed value equaling 251 ¹⁰	<p>Gas savings depend on building type and are based on measure case energy factor of 0.67 and a heating capacity of 75 MBtuh. These values are averages of qualifying units. Savings values are derived from 2008 DEER Miser, which provides MBtuh gas savings per MBtuh capacity. Savings presented here are per water heater.¹¹</p> <table> <tr> <th>Building Type</th><th>Energy Savings (therms/unit)</th></tr> <tr> <td>Assembly</td><td>185</td></tr> <tr> <td>Education – Primary/Secondary</td><td>124</td></tr> <tr> <td>Education – Post Secondary</td><td>178</td></tr> <tr> <td>Grocery</td><td>191</td></tr> <tr> <td>Health/Medical - Hospital</td><td>297</td></tr> <tr> <td>Lodging - Hotel</td><td>228</td></tr> <tr> <td>Manufacturing - Light Industrial</td><td>140</td></tr> <tr> <td>Office – > 60,000 sq-ft</td><td>164</td></tr> <tr> <td>Office – < 60,000 sq-ft</td><td>56</td></tr> <tr> <td>Restaurant - FastFood</td><td>109</td></tr> <tr> <td>Restaurant – Sit Down</td><td>166</td></tr> <tr> <td>Retail</td><td>105</td></tr> <tr> <td>Storage</td><td>150</td></tr> <tr> <td>Multi-Family</td><td>119</td></tr> </table>	Building Type	Energy Savings (therms/unit)	Assembly	185	Education – Primary/Secondary	124	Education – Post Secondary	178	Grocery	191	Health/Medical - Hospital	297	Lodging - Hotel	228	Manufacturing - Light Industrial	140	Office – > 60,000 sq-ft	164	Office – < 60,000 sq-ft	56	Restaurant - FastFood	109	Restaurant – Sit Down	166	Retail	105	Storage	150	Multi-Family	119
Building Type	Energy Savings (therms/unit)																														
Assembly	185																														
Education – Primary/Secondary	124																														
Education – Post Secondary	178																														
Grocery	191																														
Health/Medical - Hospital	297																														
Lodging - Hotel	228																														
Manufacturing - Light Industrial	140																														
Office – > 60,000 sq-ft	164																														
Office – < 60,000 sq-ft	56																														
Restaurant - FastFood	109																														
Restaurant – Sit Down	166																														
Retail	105																														
Storage	150																														
Multi-Family	119																														

¹⁰ Nicor Gas Energy Efficiency Plan 2011-2014. Revised Plan Filed Pursuant to Order Docket 10-0562, May 27, 2011. These deemed values should be compared to PY evaluation and revised as necessary

¹¹ Gas Storage Water Heater 0.67. Work Paper WPRSGNGDHW106. Resource Solutions Group. December 2010

	Other	148	
--	-------	-----	--

Measure-level Gross Savings Results

Standard Incentives

The table shown below presents the verified gross savings for measures that received standard incentives.

Annual kWh Savings for Lighting Retrofit

<i>Measure</i>					<i>Annual Gross kWh Savings</i>	
	<i>Existing Wattage</i>	<i>Efficient Wattage</i>	<i>Hours</i>	<i>WHFe</i>	<i>Ex Ante</i>	<i>TRM-Calculated Ex Post</i>
RF- LED Bulbs and Fixtures	72	44.9	4311	1.23	31,511	8,191
RF- LED Bulbs and Fixtures	144	44.9	4311	1.23		23,704
RF- LED Bulbs and Fixtures	150	44.9	4311	1		3,172
RF-Commercial LED Exit Signs	35	2	8766	1.23	2,005	3,202
RF- T5 Fixtures and Lamps	144	128	4311	1.23	7,480	5,175
RF- High Performance and Reduced Wattage T8 Fixtures and Lamps	72	49	4311	1.23	2,655	1,829
Total					43,651	45,274

The tables shown below present the verified gross savings for measures that received standard incentives.

Annual kWh Savings for Water Source Heat Pumps (WSHP)

Measure	Measure Metrics									Annual Gross kWh Savings		
	Program Type	Equipment Type	Electric Resistance heat?	Qty	Cooling Capacity (kBtu/H)	Heating Capacity (kBtu/H)	SEER _{ee}	HSPF _{ee}	Zone	Ex Ante	TRM-Calculated	ADM Calculated
											Ex Post	Ex Post
WSHP	TOS	Water Source	FALSE	1	82.0	101.0	16.7	16.4	3 (Springfield)	7,547	2,220	
WSHP	TOS	Water Source	FALSE	3	150.0	186.0	15.4	16.0	3 (Springfield)	41,617		15,574
WSHP	TOS	Water Source	FALSE	1	166.0	204.2	17.1	16.7	3 (Springfield)	15,315		7,334
WSHP	TOS	Water Source	FALSE	1	190.0	238.4	16.8	16.4	3 (Springfield)	17,535		8,037
WSHP	TOS	Water Source	FALSE	4	238.5	291.0	16.8	17.4	3 (Springfield)	87,007		43,619
WSHP	TOS	Water Source	FALSE	3	300.0	372.0	15.4	16.0	3 (Springfield)	69,474		34,056
Total										238,495	2,220	108,621

It should be noted that the last five line items shown in the above Water Source Heat Pump savings table are being reported under the “ADM Calculated” field. This is due to the Illinois TRM Version 2.0, Section 4.4.9 Heat Pump Systems, only providing baseline efficiencies for water source heat pumps with capacities under 135,000 Btus/hr. Due to this limitation ADM, relied on the efficiencies set forth by the federal appliance standards¹² for all units above 135,000 Btus/hr.

Annual Therms Savings for Gas Storage Water Heaters

Measure					Annual Gross Therms Savings	
	Program Type	Measure Type	Tank Size	Building Type	Ex Ante	TRM-Calculated
						Ex Post
Gas Water Heater	TOS	Gas, High-Efficiency	80 gallons	Education – Primary/Secondary	740	1,255
Total					740	1,255

¹² The lifetime savings were calculated by multiplying typical first year savings by the expected useful life of 15 years. California DEER Effective Useful Life worksheets: EUL_Summary_10-1-08.xls

Project-level Gross Savings Results

Annual Therms Savings for High Efficiency Boilers

Measure	Measure Metrics							Annual Gross Therms Savings		
	Program Type	Qty	Boiler btuh	Base Boiler type	Boiler Efficiency	Zone	Building Type	Ex Ante	TRM-Calculated	TRM-Calculated (Errata Corrected)
									Ex Post	Ex Post
High Efficiency Boiler	TOS	3	3,000,000	Hot Water >2,500,000 Btu/h	87.0%	3 (Springfield)	High School	9,079	9,043	7,867
Total								9,079	9,043	7,867

The tables shown below present the verified gross savings for this project.

Verified Electric Savings/Realization Rates

Incentive Type	Measure Category	Annual Gross Savings				Lifetime Gross Savings
		Ex Ante kWh	Ex Post kWh	Realization Rate	Ex Post Peak kW Reduction	Ex Post kWh
Standard	WSHP	238,495	110,840	46%	57.39	1,662,603
Standard	Lighting Retrofit	43,651	45,274	104%	1.40	405,847
Total		282,146	156,114	55%	58.79	2,068,450

Verified Natural Gas Savings/Realization Rates

Incentive Type	Measure Category	Annual Gross Savings			Lifetime Gross Savings
		Ex Ante Therms	Ex Post Therms	Realization Rate	Ex Post Therms
Standard	Gas Water Heater	740	1,255	170%	18,825
Standard	High Efficiency Boiler	9,079	7,867	87%	157,343
Total		9,819	9,122	93%	176,168

The lighting retrofit realization rate is 104%. The ex ante savings estimate was calculated with the variable for annual lighting hours selected from a data table with four building types. The ex post determined the actual function of the retrofitted spaces during the M&V site visit; and then the appropriate building type was selected from the TRM data table with 20 building types.

The water source heat pump realization rate for this project is 46%. The low realization rate can be attributed to the project assuming that the installed heat pumps were air cooled; however, they are water source heat pumps. Due to the heat pumps being water source, the baseline efficiency is much higher resulting in less energy savings.

The natural gas realization rate for this project is 93%. The realization rate for the water heater is 170%, and the boiler is 87%. This is because of ex ante assumptions used for building type. The building type has a significant impact on the gas savings for both measures. The typical building that is assumed underestimated savings for the water heater and slightly over estimated savings for the boiler.

Name S-2

Executive Summary

Application S-2 received standard incentives from Illinois DCEO for retrofitting and installing lighting, an electric steam cooker, and ground source heat pumps in their facility. The electric realization rate is 91%.

Project Description

The customer installed or retrofitted the following fixtures:

- (18) Hardwired CFL fixtures
- (28) 4' 4LT12 fixtures with (36) 4' 2LT5 fixtures
- (1) 4' 4LT12 fixture with (1) 4' 2LT5 fixture
- (51) 4' 4LT12 fixtures with (44) 4' 2LT5 fixtures
- (2) 4' 1LT8 fixtures with (2) 4' 2LT5 fixtures
- (2) 4' 3LT8 fixtures with (2) 4' 2LT5 fixtures
- (5) 4' 4LT12 fixtures with (3) 4' 2LT5 fixtures
- (2) 4' 4LT12 fixtures with (1) 4' 2LT5 fixture
- (9) 4' 4LT12 fixtures with (7) 4' 2LT8 fixtures
- (1) six pan electric steam cooker
- (27) .75 ton, (2) 1 ton, (2) 1.5 ton, (3) 2 ton, (2) 2.5 ton, (1) 3 ton, and (1) 5 ton ground source heat pumps

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified that the cooking equipment and claimed ground source heat pumps were installed. During this time ADM collected name plate information to compare against invoices and the project application. ADM staff documented fixture quantities and interviewed the site contact to verify operating hours.

Standard Incentives

Lighting energy savings were calculated according to the Illinois TRM Version 2.0.

For the lighting retrofit TRM sections 4.5.1, 4.5.3, and 4.5.12 were used.

ELECTRIC ENERGY SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * Hours * WHF_e * ISR$$

Where:

$Watts_{base}$ = input wattage of the existing system

$Watts_{EE}$ = new input wattage of EE fixture

WHF_e = waste heat factor to account for cooling energy savings

ISR = In service rate = % of units rebated that get installed

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * WHF_d * CF * ISR$$

Where:

WHF_d = waste heat factor to account for cooling demand savings

CF = Summer Peak Coincidence Factor

ADM estimated the electric steam cooker energy savings according to the Illinois TRM Version 2.0, Section 4.2.3 Commercial Steam Cooker.

ELECTRIC ENERGY SAVINGS

$$\Delta Savings = (\Delta Idle + \Delta Preheat + \Delta Cooking) * Days/Year$$

Where:

$$\Delta Idle \text{ Energy} = (((1 - CSM_{\%Baseline}) * IDLE_{BASE} + CSM_{\%Baseline} * PC_{BASE} * E_{FOOD} / EFF_{BASE}) * (HOURS_{day} - (F / PC_{BASE}) - (PRE_{number} * 0.25))) - (((1 - CSM_{\%ENERGYSTAR}) * IDLE_{ENERGYSTAR} + CSM_{\%ENERGYSTAR} * PC_{ENERGY} * E_{FOOD} / EFF_{ENERGYSTAR}) * (HOURS_{Day} - (F / PC_{ENERGY}) - (PRE_{number} * 0.25))))$$

CSM_{%Baseline} = Baseline Steamer Time in Manual Steam Mode (% of time)

= 90%

IDLE_{Base} = Idle Energy Rate of Base Steamer

PC_{Base} = Production Capacity of Base Steamer

E_{FOOD} = Amount of Energy Absorbed by the food during cooking known as ASTM Energy to Food (Btu/lb or kW/lb)

= 105 Btu/lb (gas steamers) or 0.0308 (electric steamers)

EFF_{Base} = Heavy Load Cooking Efficiency for Base Steamer

= 15% (gas steamers) or 26% (electric steamers)

HOURS_{day} = Average Daily Operation (hours)

F = Food cooked per day (lbs/day)

= custom or if unknown, use 100 lbs/day

CSM_{%ENERGYSTAR} = ENERGY STAR Steamer's Time in Manual Steam Mode (% of time)

= 0%

$IDLE_{ENERGYSTAR}$	= Idle Energy Rate of ENERGY STAR®
PC_{ENERGY}	= Production Capacity of ENERGY STAR® Steamer
$EFF_{ENERGYSTAR}$	= Heavy Load Cooking Efficiency for ENERGY STAR® Steamer(%) =38% (gas steamer) or 50% (electric steamer)
PRE_{number}	= Number of preheats per day =1 (if unknown, use 1)
$\Delta Preheat\ Energy$	= ($PRE_{number} * \Delta Pre_{heat}$)
PRE_{number}	= Number of Preheats per Day =1 (if unknown, use 1)
PRE_{heat}	= Preheat energy savings per preheat = 11,000 Btu/preheat (gas steamer) or 0.5 kWh/preheat (electric steamer)
$\Delta Cooking\ Energy$	= ((1/ EFF_{BASE}) - (1/ $EFF_{ENERGYSTAR}$)) * F * E_{FOOD}
EFF_{BASE}	=Heavy Load Cooking Efficiency for Base Steamer =15% (gas steamer) or 26% (electric steamer)
$EFF_{ENERGYSTAR}$	=Heavy Load Cooking Efficiency for ENERGY STAR® Steamer =38% (gas steamer) or 50% (electric steamer)
F	= Food cooked per day (lbs/day) = custom or if unknown, use 100 lbs/day
E_{FOOD}	= Amount of Energy Absorbed by the food during cooking known as ASTM Energy to Food

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kW = \frac{\Delta kWh}{HOURS_{Day} * Days_{Year}} * CF$$

Where:

CF	=Summer Peak Coincidence Factor for measure
$Days_{Year}$	=Annual Days of Operation, custom or 365.25 days a year

ADM estimated the ground source heat pump energy savings according to the Illinois TRM Version 2.0, Section 4.4.9 Heat Pump Systems.

ELECTRIC ENERGY SAVINGS

For units with cooling capacities less than 65 kBtu/h:

$$\Delta \text{kWh} = \text{Annual kWh Savings}_{\text{cool}} + \text{Annual kWh Savings}_{\text{heat}}$$

$$\text{Annual kWh Savings}_{\text{cool}} = (\text{kBtu}/\text{h}_{\text{cool}}) * [(1/\text{SEER}_{\text{base}}) - (1/\text{SEER}_{\text{ee}})] * \text{EFLH}_{\text{cool}}$$

$$\text{Annual kWh Savings}_{\text{heat}} = (\text{kBtu}/\text{h}_{\text{cool}}) * [(1/\text{HSPF}_{\text{base}}) - (1/\text{HSPF}_{\text{ee}})] * \text{EFLH}_{\text{heat}}$$

For units with cooling capacities equal to or greater than 65 kBtu/h:

$$\Delta \text{kWh} = \text{Annual kWh Savings}_{\text{cool}} + \text{Annual kWh Savings}_{\text{heat}}$$

$$\text{Annual kWh Savings}_{\text{cool}} = (\text{kBtu}/\text{h}_{\text{cool}}) * [(1/\text{EER}_{\text{base}}) - (1/\text{EER}_{\text{ee}})] * \text{EFLH}_{\text{cool}}$$

$$\text{Annual kWh Savings}_{\text{heat}} = (\text{kBtu}/\text{h}_{\text{heat}})/3.412 * [(1/\text{COP}_{\text{base}}) - (1/\text{COP}_{\text{ee}})] * \text{EFLH}_{\text{heat}}$$

Where:

kBtu/h _{cool}	= capacity of the cooling equipment in kBtu per hour (1 ton of cooling capacity equals 12 kBtu/h). = Actual installed
SEER _{base}	= Seasonal Energy Efficiency Ratio of the baseline equipment; see table below for values.
SEER _{ee}	= Seasonal Energy Efficiency Ratio of the energy efficient equipment. = Actual installed
EFLH _{cool}	= cooling mode equivalent full load hours
HSPF _{base}	= Heating Seasonal Performance Factor of the baseline equipment; see table above for values.
HSPF _{ee}	= Heating Seasonal Performance Factor of the energy efficient equipment. = Actual installed
EFLH _{heat}	= heating mode equivalent full load hours; see table above for default values.
EER _{base}	= Energy Efficiency Ratio of the baseline equipment; see the table above for values. Since IECC 2006 does not provide EER requirements for air-cooled heat pumps < 65 kBtu/h, assume the following conversion from SEER to EER: EER ≈ SEER/1.1.
EER _{ee}	= Energy Efficiency Ratio of the energy efficient equipment. For air-cooled air conditioners < 65 kBtu/h, if the actual EER _{ee} is unknown, assume the following conversion from SEER to EER: EER ≈ SEER/1.1. = Actual installed
kBtu/h _{heat}	= capacity of the heating equipment in kBtu per hour. = Actual installed
3.412	= Btu per Wh.

COP_{base} = coefficient of performance of the baseline equipment; see table above for values.

CO_{Pee} = coefficient of performance of the energy efficient equipment.

= Actual installed

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kW = (kBtu/h_{cool}) * [(1/EER_{base}) - (1/EER_{ee})] * CF$$

CF_{SSP} = Summer System Peak Coincidence Factor for Commercial cooling (during system peak hour)

= 91.3%

CF_{PJM} = PJM Summer Peak Coincidence Factor for Commercial cooling (average during peak period)

Measure-level Gross Savings Results

Standard Incentives

The tables shown below present the verified gross savings for measures that received standard incentives.

Annual kWh Savings for Lighting Retrofit

<i>Measure</i>					<i>Annual Gross kWh Savings</i>	
	<i>Existing Wattage</i>	<i>Efficient Wattage</i>	<i>Hours</i>	<i>WHFe</i>	<i>Ex Ante</i>	<i>TRM-Calculated Ex Post</i>
Commercial Energy Star Standard CFL	0	36	4311	1.23	554	1,211
Commercial Energy Star Standard CFL	0	55	4311	1.23	-	942
Commercial Energy Star Standard CFL	0	46	4311	1.23	-	269
RF – T5 Fixtures and Lamps	139	64	4311	1.23	9,754	8,420
RF – T5 Fixtures and Lamps	139	64	4311	1.23	355	398
RF – T5 Fixtures and Lamps	139	64	4311	1.23	25,410	22,658
RF – T5 Fixtures and Lamps	32	64	4311	1.23	200-	(339)
RF – T5 Fixtures and Lamps	88	64	4311	1.23	-	255
RF – T5 Fixtures and Lamps	139	64	4311	1.23	3,096	2,667
RF – T5 Fixtures and Lamps	139	64	4311	1.23	1,215	1,135
RF – High Performance and Reduced Wattage T8 Fixtures and Lamps	139	49	4311	1.23	5,948	4,815
Total					46,532	42,429

Annual kWh Savings for Commercial Steam Cooker

<i>Measure</i>	<i>Measure Metrics</i>				<i>Annual Gross kWh Savings</i>	
	<i>Program Type</i>	<i>Equipment Type</i>	<i>No. of Pans</i>	<i>Type of Food Service</i>	<i>Ex Ante</i>	<i>TRM-Calculated Ex Post</i>
<i>Commercial Steam Cooker</i>	<i>TOS</i>	<i>Electric Steam Cooker</i>	<i>6</i>	<i>Cafeteria</i>	<i>2,153</i>	<i>2,153</i>
Total					2,153	2,153

Annual kWh Savings for Ground Source Heat Pumps

Measure	Measure Metrics									Annual Gross kWh Savings	
	Program Type	Equipment Type	Electric Resistance heat?	Qty	Cooling Capacity (kBtu/H)	Heating Capacity (kBtu/H)	SEER _{ee}	HSPF _{ee}	Zone	Ex Ante	TRM-Calculated
											Ex Post
WSHP	TOS	Water Source	FALSE	27	9.3	11.1	16.8	16.4	³ (Springfield)	7,768	7,781
WSHP	TOS	Water Source	FALSE	2	11.7	13.8	16.9	15.4	³ (Springfield)	1,110	632
WSHP	TOS	Water Source	FALSE	2	18.6	23.0	16.5	17.7	³ (Springfield)	1,110	1,111
WSHP	TOS	Water Source	FALSE	3	25.1	29.5	17.8	16.7	³ (Springfield)	2,372	2,261
WSHP	TOS	Water Source	FALSE	2	28.2	34.9	16.8	17.1	³ (Springfield)	2,220	1,612
WSHP	TOS	Water Source	FALSE	1	33.0	39.8	18.3	18.8	³ (Springfield)	1,186	1,274
WSHP	TOS	Water Source	FALSE	1	61.0	70.4	17.5	17.1	³ (Springfield)	2,372	1,830
Total										18,138	16,502

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Electric Savings/Realization Rates

Incentive Type	Measure Category	Annual Gross Savings				Lifetime Gross Savings
		Ex Ante kWh	Ex Post kWh	Realization Rate	Ex Post Peak kW Reduction	Ex Post kWh
Standard	Lighting Retrofit	46,532	42,429	91%	1.37	408,832
Standard	Electric Steam Cooker	2,153	2,153	100%	0.35	25,838
Standard	WSHP	18,138	16,502	3%	10.82	247,523
Total		66,823	61,084	91%	12.54	682,193

The project-level realization rate is 91%. The ex ante estimate for the T5 and T8 measures assumed a greater than was determined in the ex post savings analysis by using the TRM prescribed figures. The ex ante savings calculation included the difference in the actual baseline

watts for the sum of all fixtures less the actual watts for the retrofit fixtures. The ex post savings calculation utilized the actual fixtures as found during the site visit and the deemed savings by fixture type from the TRM. During the M&V site visit, ADM also verified the installation of Occupancy Sensors, but this measure was not in the application and a Standard incentive was not received.

The ground-source heat pumps realization rate is 91%. The low realization rate can be attributed to the project assuming that the installed heat pumps were air cooled; however they are water source heat pumps. Due to the heat pumps being water source, the baseline efficiency is much higher resulting in a net reduction of savings.

Name S-3, C-1

Executive Summary

Application S-3, C-1 received standard incentives from Illinois DCEO for installing ground source heat pumps, unitary air conditioners, and a storage water heater. They also received custom incentives for a new control system. The electric realization for this project is 62%, and the natural gas realization is 313%.

Project Description

The participant installed ground source heat pumps in Building A to replace an existing VVT system. In Buildings C, D and E, they installed (6) roof-top units to replace the original roof-top units nearing the end of their useful life. The new roof-top units use the existing hot water system. The baseline system was tied into a control system but had no scheduling. The new control system in Buildings C, D and E utilizes occupancy scheduling with temperature setback.

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified that the equipment was installed and operational, documented new equipment nameplate data, and gathered temperature set points and scheduling information from the building automation system.

Standard Incentives

ELECTRIC ENERGY SAVINGS

ADM estimated energy savings resulting from the new ground source heat pumps heat pumps using the Illinois TRM Version 2.0, Section 4.4.9 Heat Pump Systems, which provided the following equations:

For units with cooling capacities less than 65kbtu/h:

$$\Delta kWh_{cool} = EFLH_{cool} * Capacity_{cool} * \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{actual}} \right)$$

$$\Delta kWh_{heat} = EFLH_{heat} * Capacity_{heat} * \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{actual}} \right)$$

For units with cooling capacities greater than or equal to 65kbtu/h:

$$\Delta kWh_{cool} = EFLH_{cool} * Capacity_{cool} * \left(\frac{1}{EER_{base}} - \frac{1}{EER_{actual}} \right)$$

$$\Delta kWh_{heat} = EFLH_{heat} / 3.412 * Capacity_{heat} * \left(\frac{1}{COP_{base}} - \frac{1}{COP_{actual}} \right)$$

Where:

$EFLH_{cool}$	= Equivalent Full Load Hours for cooling
$EFLH_{heat}$	= EFLH for heating
$Capacity_{cool}$	= Cooling Capacity (kBtu/h)
$Capacity_{heat}$	= Heating Capacity (kBtu/h)
$SEER_{base}$	= Baseline Seasonal Energy Efficiency Ratio (deemed)
$SEER_{actual}$	= As-built Seasonal Energy Efficiency Ratio
$HSPF_{base}$	= Baseline Heating Seasonal Performance Factor (deemed)
$HSPF_{actual}$	= Actual HSPF of energy efficient equipment
EER_{base}	= Energy Efficiency Ratio of the baseline equipment (deemed)
EER_{actual}	= Actual EER of energy efficient equipment

ADM estimated energy savings resulting from the new unitary air conditioners using the Illinois TRM Version 2.0, Section 4.4.14 provided the following formula for electric energy savings:

For units with cooling capacities less than 65kbtu/h:

$$\Delta kWh_{cool} = EFLH_{cool} * Capacity_{cool} * \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{actual}} \right)$$

For units with cooling capacities greater than or equal to 65kbtu/h:

$$\Delta kWh_{cool} = EFLH_{cool} * Capacity_{cool} * \left(\frac{1}{EER_{base}} - \frac{1}{EER_{actual}} \right)$$

Where:

$EFLH_{cool}$	= Equivalent Full Load Hours for cooling
$Capacity_{cool}$	= Cooling Capacity (kBtu/h)
$SEER_{base}$	= Baseline Seasonal Energy Efficiency Ratio (deemed)
$SEER_{actual}$	= As-built Seasonal Energy Efficiency Ratio
EER_{base}	= Energy Efficiency Ratio of the baseline equipment (deemed)
EER_{actual}	= Actual EER of energy efficient equipment

NATURAL GAS ENERGY SAVINGS

ADM estimated energy savings resulting from the new storage water heater using the Illinois TRM Version 2.0, Section 4.3.1 Storage Water Heater. This chapter provides a deemed savings of 251 therms for a high efficiency (>88%) storage water heater.

Custom Incentives

ADM performed an energy simulation in eQUEST to estimate savings resulting from the implementation of unoccupied scheduling and temperature setback for the new rooftop units in Buildings C, D and E. To do so, ADM used a prototypical model for community colleges and customized the scheduling and set point parameters to match the baseline and as-built facilities. Model savings were calculated as the difference between the baseline and as-built consumption. Model savings were then normalized by scaling to the conditioned area of Buildings C, D, and E.

Measure-level Gross Savings Results

Standard Incentives

The tables shown below present the verified gross savings for measures that received standard incentives.

Annual kWh Savings for Ground Source Heat Pumps

Measure	Measure Metrics									Annual Gross kWh Savings	
	Program Type	Equipment Type	Electric Resistance heat?	Qty	Cooling Capacity (kBtu/H)	Heating Capacity (kBtu/H)	SEER _{ee}	HSPF _{ee}	Zone	Ex Ante	TRM-Calculated
											Ex Post
GSHP	RF	Ground Source Heat Pump	FALSE	2	58.5	38.0	23.8	13.8	2 (Chicago)		4,269
GSHP	RF	Ground Source Heat Pump	FALSE	13	49.5	30.0	24.6	13.1	2 (Chicago)		22,042
GSHP	RF	Ground Source Heat Pump	FALSE	9	35.6	22.0	24.8	13.1	2 (Chicago)		11,097
GSHP	RF	Ground Source Heat Pump	FALSE	3	34.6	25.8	22.2	14.3	2 (Chicago)		3,990
Total										174,484	41,398

Annual kWh Savings for Unitary Air Conditioners

Measure	Measure Metrics								Annual Gross kWh Savings	
	Program Type	Equipment type	Subcategory or rating Condition	Qty	New Cooling Capacity (kbtu/h)	EER of Efficient Equipment	Zone	Electric Resistance Heat?	Ex Ante	TRM-Calculated Ex Post
Single-Package and Split System Unitary Air Conditioners	RF	Air conditioners, Air cooled	Single Package	1	684	11.0	² (Chicago)	N	2,829	6,236
Single-Package and Split System Unitary Air Conditioners	RF	Air conditioners, Air cooled	Single Package	1	696	11.0	² (Chicago)	N	2,879	6,345
Single-Package and Split System Unitary Air Conditioners	RF	Air conditioners, Air cooled	Single Package	1	456	10.9	² (Chicago)	N	1,886	3,846
Single-Package and Split System Unitary Air Conditioners	RF	Air conditioners, Air cooled	Single Package	1	684	10.8	² (Chicago)	N	2,829	5,293
Single-Package and Split System Unitary Air Conditioners	RF	Air conditioners, Air cooled	Single Package	1	401	10.8	² (Chicago)	N	1,658	3,101
Single-Package and Split System Unitary Air Conditioners	RF	Air conditioners, Air cooled	Single Package	1	655	10.8	² (Chicago)	N	2,710	5,070
Total									14,791	29,891

Annual Therms Savings for Storage Water Heater

Measure	Measure Metrics		Annual Gross Therms Savings	
	Qty	Thermal Efficiency	Ex Ante	TRM-Calculated Ex Post
Storage Water Heater	1	96%	178	251
Total			178	251

Custom Incentives

The tables shown below present the verified gross savings for measures that received custom incentives.

Annual kWh Savings for HVAC Controls

Measure	Measure Metrics			Annual Gross kWh Savings	
	Area (ft ²)	Cooling Capacity (kbtu/h)	Heating Capacity (kbtu/h)	Ex Ante	ADM Calculated Ex Post
Unoccupied Scheduling and Temp. Setback	108,952	3,576	18,000	116,266	118,122
Total				116,266	118,122

Annual Therms Savings for HVAC Controls

Measure	Measure Metrics			Annual Gross kWh Savings	
	Area (ft ²)	Cooling Capacity (kbtu/h)	Heating Capacity (kbtu/h)	Ex Ante	ADM Calculated Ex Post
Unoccupied Scheduling and Temp. Setback	108,952	3,576	18,000	6,754	21,420
Total				6,754	21,420

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Electric Savings/Realization Rates

Incentive Type	Measure Category	Annual Gross Savings				Lifetime Gross Savings
		Ex Ante kWh	Ex Post kWh	Realization Rate	Ex Post Peak kW Reduction	Ex Post kWh
Standard	Ground Source Heat Pumps	174,484	41,398	24%	31.85	620,972
Standard	Unitary AC	14,793	29,891	202%	33.32	448,371
<i>Subtotal</i>		<i>189,277</i>	<i>71,289</i>	<i>38%</i>	<i>65.17</i>	<i>1,069,343</i>
Custom	Controls	116,266	118,122	102%	0	1,771,823
<i>Subtotal</i>		<i>116,266</i>	<i>118,122</i>	<i>102%</i>	<i>0</i>	<i>1,771,823</i>
Total		305,543	189,411	62%	65.17	2,841,166

Verified Natural Gas Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>			<i>Lifetime Gross Savings</i>
		<i>Ex Ante Therms</i>	<i>Ex Post Therms</i>	<i>Realization Rate</i>	<i>Ex Post Therms</i>
Standard	Storage Water Heater	178	251	141%	3,765
<i>Subtotal</i>		<i>178</i>	<i>251</i>	<i>141%</i>	<i>3,765</i>
Custom	Controls	6,754	21,420	317%	321,301
<i>Subtotal</i>		<i>6,754</i>	<i>21,420</i>	<i>317%</i>	<i>321,301</i>
<i>Total</i>		<i>6,932</i>	<i>21,671</i>	<i>313%</i>	<i>325,066</i>

The overall project realization rate is 62% for electric and 313% for natural gas. The low realization rate for the ground source heat pumps appears to be attributed to the ex-ante savings claiming 174,484 kWh for both annual savings and lifetime savings. The 174,484 kWh is more appropriate for lifetime savings and leads ADM to believe that this is an error within the IEN database. This error is the reason the overall electric realization rate is low for the project.

Ex-ante savings (178 Therms) for the storage water heater were based on a standard efficiency unit; however, the actual unit installed was a high efficiency unit. The Illinois TRM Version 2.0 estimates savings of 251 Therms per high efficiency unit. The realization rate for this measure is 141%.

The ex ante savings calculation estimated that the HVAC controls would save 15% of the HVAC energy and natural gas used in the 2011-2012 usage period; however, the assumptions used for this estimation are unknown, as the calculations provided with project documentation were not comprehensive. ADM determined savings using a prototypical community college energy model and typical weather data for the Peoria (Greater Peoria) weather station. The electric realization rate for this measure is 102% and the natural gas realization rate is 317%.

Name S-4

Executive Summary

Application S-4 received standard incentives from Illinois DCEO for installing natural gas furnaces and electric heat pumps. The natural gas realization rate is 19%, and the electric realization rate is 156%.

Project Description

The participant installed (6) 80 MBH York natural gas furnaces to replace (5) 106 MBH Lennox furnaces in one building and (1) unknown make and size furnace in another building. Also installed were (2) 5-ton, (3) 4-ton, and (1) 3-ton York cooling heat pumps. Based on mechanical schedules provided by the site staff, there was previously no air conditioning. The new gas furnaces are tied into the same air system as the new electric heat pumps.

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified that the equipment was installed and operational and documented equipment nameplate data, temperature set points, and mechanical schedules for the baseline system in the Burl Ives building.

Standard Incentives

NATURAL GAS ENERGY SAVINGS

ADM estimated energy savings according to the Errata Corrected Illinois TRM Version 3.0, Section 4.4.11 High Efficiency Furnace, which provided the following equation:

$$\Delta Therm = EFLH * Capacity * \left(\frac{1}{AFUE_{base}} - \frac{1}{AFUE_{efficient}} \right)$$

Where:

$AFUE$ = Annual Fuel Utilization Efficiency Rating

ELECTRIC ENERGY SAVINGS

ADM estimated energy savings resulting from the new heat pumps using the Illinois TRM Version 2.0, Section 4.4.9 Heat Pump Systems, which provided the following equations:

$$\Delta kWh_{cool} = EFLH_{cool} * Capacity_{cool} * \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{actual}} \right)$$

$$\Delta kWh_{heat} = EFLH_{heat} * Capacity_{heat} * \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{actual}} \right)$$

Where:

$EFLH_{cool}$ = Equivalent Full Load Hours for cooling

$Capacity_{cool}$ = Cooling capacity (kBtu/h)

$SEER_{base}$ = baseline seasonal energy efficiency ratio (deemed)

$SEER_{actual}$ = as-built seasonal energy efficiency ratio

Because the heat pumps do not provide heating, the equation for savings from heating was ignored for this measure.

SPILLOVER

Spillover occurred in the form of energy savings from furnace fan usage. The Illinois TRM Version 3.0, Section 4.4.11 provided the following formula for electric energy savings:

$$\Delta kWh = Heating + Cooling + Shoulder Season$$

Where:

$$Heating = 418kWh$$

$$Cooling = \text{Deemed Savings in TRM}$$

$$Shoulder Season = 51kWh$$

Measure-level Gross Savings Results

Standard Incentives

The tables shown below present the verified gross savings for measures that received standard incentives.

Annual Therms Savings for High Efficiency Furnaces

Measure	Measure Metrics					Annual Gross Therms Savings		
	Program Type	Qty	Furnace MBH	AFUE	Zone	Ex Ante	TRM-Calculated Ex Post	TRM-Calculated (Errata Corrected) Ex Post
High Efficiency Furnace	RF	6	80	96%	3 (Springfield)	358	376	361
Total						358	376	361

Annual kWh Savings for High Efficiency Furnaces

Measure	Measure Metrics							Annual Gross kWh Savings		
	Program Type	Qty	AC or No AC	Efficient Measure	Building Type	Zone	Furnace Capacity (BTUH)	Ex Ante	TRM-Calculated Ex Post	TRM-Calculated (Errata Corrected) Ex Post
High Eff. Furnace	TOS	6	Air Conditioning	92.1%	College/University	3 (Springfield)	80,000	2,272	4,392	4,392
Total								2,272	4,392	4,392

Annual kWh Savings for Heat Pumps

<i>Measure</i>	<i>Measure Metrics</i>				<i>Annual Gross Savings</i>	
	<i>Program Type</i>	<i>Qty</i>	<i>Tons</i>	<i>SEER</i>	<i>Ex Ante kWh</i>	<i>TRM-Calculated Ex Post kWh</i>
Heat Pump System	TOS	2	5	16	496	1,733
Heat Pump System	TOS	3	4	15	596	1,478
Heat Pump System	TOS	1	3	15	148	370
Total					1,240	3,581

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Natural Gas Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>			<i>Lifetime Gross Savings</i>
		<i>Ex Ante Therms</i>	<i>Ex Post Therms</i>	<i>Realization Rate</i>	<i>Ex Post Therms</i>
Standard	High Efficiency Furnace	358	361	101%	5,956
Total		358	361	101%	5,956

Verified Electric Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>				<i>Lifetime Gross Savings</i>
		<i>Ex Ante kWh</i>	<i>Ex Post kWh</i>	<i>Ex Post kW</i>	<i>Realization Rate</i>	<i>Ex Post kWh</i>
Standard	Heat Pump System	1,240	3,581	0.90	289%	59,078
Standard	High Efficiency Furnace	2,272	4,392	3.50	193%	87,840
Total		3,512	7,973	4.00	227%	146,918

The ex ante natural gas savings estimate is calculated using a deemed savings of 0.746 therms per kBtu/h based on a “college/university” facility type, but the assumptions applied to this savings value are unknown. The Illinois TRM version 3.0 determines EFLH based on building

type and climate zone and applies a baseline boiler efficiency rating based on system type. This results in an ex post savings of 0.752 therms per kBtuh. The natural gas realization rate is 101%

The ex ante electric savings estimate for unitary and split system air conditioning and heat pumps uses a deemed savings of 49.6 kWh per ton of cooling capacity based on a “college/university” facility type and equipment SEER of 15, but other assumptions are unknown. The Illinois TRM version 2.0 determines EFLH based on climate zone and determines the baseline system efficiency based on equipment type and size. This results in a savings of 143.2 kWh per ton of cooling capacity. Additionally, the ex ante savings estimate for natural gas furnaces applies savings of 4.73 kWh per kBtuh based on “college/university” facility type. The TRM version 3.0 applies savings for each unit of 732 kWh, resulting in savings of 9.15 kWh per kBtuh. The electric realization rate is 227%.

Name S-5

Executive Summary

Application S-5 received standard incentives from DCEO for installing lighting fixtures, low flow faucet aerators, and beverage machine controls in their facility. The electric realization rate is 113%, and the natural gas realization rate is 433%.

Project Description

The customer installed (5) low flow faucet aerators in restrooms and a beverage machine controller. There was also delamping of 4-foot and 8-foot lamps, retrofitting T12 to T8 4-foot lamps and 2-foot lamps, installation of LED exit signs, installation of LED fixtures, installation of LED wall packs, replacement of metal halides with T8 fluorescent fixtures, and installation of exterior LED fixtures.

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified that the equipment was installed; however, the beverage machine controls were installed on an Energy Star unit, which controls the machine in the same manner as the Beverage Miser. Thus, savings are zero for this measure. There were a few discrepancies in that there were fewer installed fixtures than expected, but the site contact indicated that some of the new fixtures are in storage.

Standard Incentives

Energy savings were calculated according to the Illinois TRM Version 2.0.

For the lighting retrofit TRM section 4.5 was used.

ELECTRIC ENERGY SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * Hours * WHF_e * ISR$$

Where:

$Watts_{base}$	= input wattage of the existing system
$Watts_{EE}$	= new input wattage of EE fixture
WHF_e	= waste heat factor to account for cooling energy savings
ISR	= In service rate = % of units rebated that get installed

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * WHF_d * CF * ISR$$

Where:

WHF_d	= waste heat factor to account for cooling demand savings
---------	---

CF = Summer Peak Coincidence Factor

ADM estimated energy savings according to the Illinois TRM Version 3.0, Section 4.3.2 Low Flow Faucet Aerators.

NATURAL GAS ENERGY SAVINGS

$$\Delta \text{Therms} = \% \text{FossilDHW} * ((\text{GPM_base} - \text{GPM_low}) / \text{GPM_base}) * \text{Usage} * \text{EPG_gas} * \text{ISR}$$

Where:

%FossilDHW = proportion of water heating supplied by fossil fuel heating = 100%

GPM_base = Average flow rate, in gallons per minute, of the baseline faucet “as-used”

= 1.2 or custom based on metering studies

GPM_low = Average flow rate, in gallons per minute, of the low-flow faucet aerator “as-used”

= 0.94 or custom based on metering studies

Usage = Estimated usage of mixed water (mixture of hot water from water heater line and cold water line) per faucet (gallons per year)

EPG_gas = Energy per gallon of mixed water used by faucet (gas water heater)

= $(8.33 * 1.0 * (\text{WaterTemp} - \text{SupplyTemp})) / (\text{RE_gas} * 100,000)$

= 0.00446 Therm/gal

Where:

RE_gas = Recovery efficiency of gas water heater

= 67%

100,000 = Converts Btus to Therms (Btu/Therm)

ISR = In service rate = deemed value based on direct install = 95%

Measure-level Gross Savings Results

Standard Incentives

The tables shown below present the verified gross savings for measures that received standard incentives.

Annual kWh Savings for Lighting Retrofit

<i>Measure</i>					<i>Annual Gross kWh Savings</i>	
	<i>Existing Wattage</i>	<i>Efficient Wattage</i>	<i>Hours</i>	<i>WHFe</i>	<i>Ex Ante</i>	<i>TRM-Calculated Ex Post</i>
RF - Fluorescent Delamping	33.7	0	4439	1.25	65,626	67,317
RF - High Performance and Reduced Wattage T8 Fixtures and Lamps	92	49	4439	1.25	70,138	47,958
RF - High Performance and Reduced Wattage T8 Fixtures and Lamps	82	49	4439	1.25		32,960
RF - High Performance and Reduced Wattage T8 Fixtures and Lamps	46	25	4439	1.25		2,863
RF - High Performance and Reduced Wattage T8 Fixtures and Lamps	68	49	4439	1.25		1,160
RF - High Performance and Reduced Wattage T8 Fixtures and Lamps	92	49	4439	1.25	1,055	1,071
TOS/NC/RF - LED Screw Bulbs	65	9.5	3088	1.25	2,776	926
TOS/NC/RF - LED Screw Bulbs	60	12	3088	1.25		185
TOS/NC/RF - LED Screw Bulbs	25	9	3088	1.25		233
RF - High Performance and Reduced Wattage T8 Fixtures and Lamps	455	206	4439	1.25	42,259	44,212
RF - Commercial LED Exit Signs	35	2	8766	1.25	8,974	14,102
TOS/NC/RF - LED Bulbs and Fixtures	455	104	4903	1	1,222	3,442
TOS/NC/RF - LED Bulbs and Fixtures	285	52	4903	1	3,435	5,712
TOS/NC/RF - LED Bulbs and Fixtures	115	18	4903	1	3,418	1,427
RF - Fluorescent Delamping	60.3	0	4439	1.25	3,206	7,361
TOS/NC/RF - LED Bulbs and Fixtures	201	26	4903	1	492	1,716
Total					202,603	232,646

Annual Therms Savings for Low Flow Faucet Aerators

<i>Measure</i>			<i>Annual Gross Therms Savings</i>		
	<i>Quantity</i>	<i>Building Type</i>	<i>Ex Ante</i>	<i>TRM-Calculated Ex Post</i>	<i>TRM-Calculated (Errata Corrected) Ex Post</i>
Low Flow Faucet Aerators	5	Large Office	12	52	52
Total			12	52	52

Annual kWh Savings for Refrigerated Beverage Machine Controls

<i>Measure</i>		<i>Annual Gross kWh Savings</i>	
	<i>Quantity</i>	<i>Ex Ante</i>	<i>TRM-Calculated Ex Post</i>
Beverage and Snack Machine Controls	1	3,226	0
Total		3,226	0

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Natural Gas Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>			<i>Lifetime Gross Savings</i>
		<i>Ex Ante Therms</i>	<i>Ex Post Therms</i>	<i>Realization Rate</i>	<i>Ex Post Therms</i>
Standard	Low Flow Faucet Aerators	12	52	433%	465
Total		12	52	433%	465

Verified Electric Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>				<i>Lifetime Gross Savings</i>
		<i>Ex Ante kWh</i>	<i>Ex Post kWh</i>	<i>Realization Rate</i>	<i>Ex Post Peak kW Reduction</i>	<i>Ex Post kWh</i>
Standard	Beverage and Snack Machine Controls	3,226	0	0%	0	0
Standard	Lighting Retrofit	202,603	232,646	115%	33.14	2,381,965
Total		205,829	232,646	113%	33.14	2,381,965

The ex ante natural gas savings estimate is calculated using a deemed savings of 4.54 therms per low flow faucet aerator for offices, but the assumptions applied to this savings value are unknown. The Illinois TRM uses average flow rates and water usage to estimate savings from the faucet aerators, resulting in a savings of 10.4 therms per aerator. The natural gas realization rate is 433%

The ex ante electric savings estimate uses a deemed savings of 1,612 kWh per beverage machine control. The M&V site visit found that the beverage machine was installed on an Energy Star beverage machine, which rendered the installed controller useless. The electric realization rate is 0%.

The verified standard measure electric realization rate is 115%. The ex-ante savings estimation results from deemed savings values for each measure based on the facility type “office”. The ex-post savings estimation is based on the Illinois TRM Version 2.0, which considers usage hours based on space type and fixture type and allows for the use of custom baseline and energy efficient equipment wattage to estimate savings.

Name C-2

Executive Summary

Application C-2 received custom-measure incentives from Illinois DCEO for installing a new turbo blower at their Plant. The electric realization rate is 37%.

Project Description

The customer installed (1) HSi turbo blower with dissolved oxygen feedback control to take over the load for the aeration and aerobic digester tanks. The previous system rotated (3) 125 HP and (1) 75 HP Hoffman blowers in and out of service. They have been left in place as back-up.

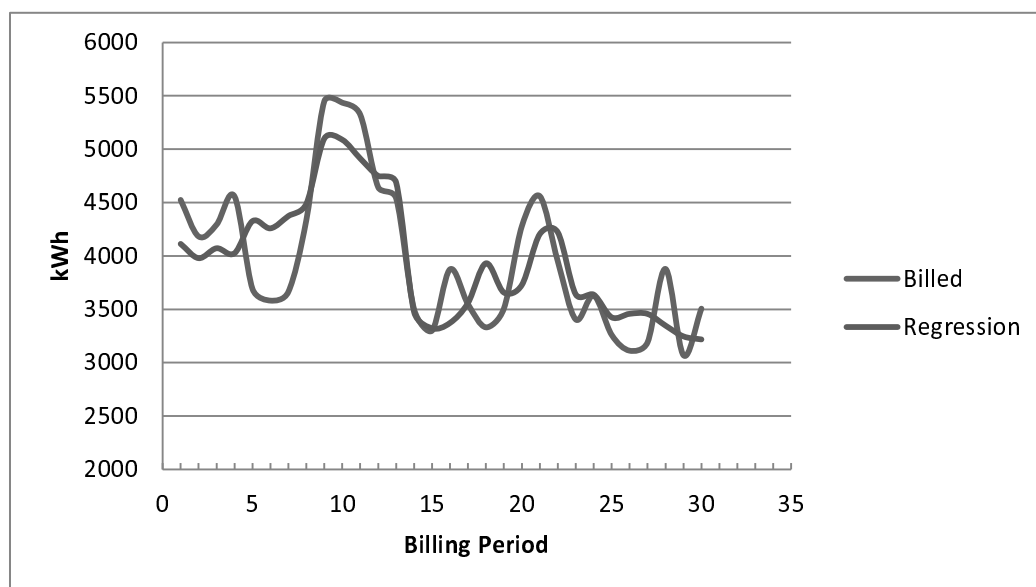
Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified that the equipment was installed and operational and photographed the new and existing equipment. Pre- and post- project plant flow, CFM, and temperature data was provided to be used in the energy savings analysis.

ADM performed a regression using billing data as the dependent variable and using daily average influent and effluent flow, plant temperature, and a binary variable used to indicate pre- and post- project as the dependent variables. The regression results are shown below.

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	3210.99004	387.3427	8.28979
Daily Influent	1583.25012	527.4284	3.00183
Daily Effluent	1056.94516	480.0508	2.20174
Plant Avg Temp	-7.51031	3.8657	1.94281
PrePost	809.05657	155.6913	5.19654

<i>Regression Statistics</i>	
Multiple R	0.8342035
R Square	0.6958954
Adjusted R Square	0.6491101
Standard Error	401.2454108
Observations	31

Billed Usage vs. Regression

Measure-level Gross Savings Results

Custom Incentives

The tables shown below present the verified gross savings for measures that received custom incentives.

Annual kWh Savings for Turbo Blower

Measure	Regression Coefficients					Annual Gross kWh Savings	
	Daily Influent	Daily Effluent	Plant Avg. Temp	PrePost	Intercept	Ex Ante	ADM Calculated Ex Post
Turbo blower	1,583.3	-1,056.9	-7.5	809.1	3,211.0	790,412	295,508
Total						<i>790,412</i>	<i>295,508</i>

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Electric Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>				<i>Lifetime Gross Savings</i>
		<i>Ex Ante kWh</i>	<i>Ex Post kWh</i>	<i>Realization Rate</i>	<i>Ex Post Peak kW Reduction</i>	<i>Ex Post kWh</i>
Custom	Turbo blower	790,412	295,508	37%	33.71	5,910,160 ¹³
Total		790,412	295,508	37%	33.71	5,910,160

The realization rate for this project is 37%. Engineering calculations used for the ex ante savings were provided with documentation. These calculations accounted for a much lower air demand (1,416 CFM average) than is shown in the data that was provided to ADM (2,782 CFM average), so the new blower is actually running at a higher speed, which is very impactful due to the cubic relationship between fan speed and power.

¹³The life expectancy is estimated to be 20 years. See:

http://www.energy.siemens.com/us/pool/hq/compression/special-applications/aeration/Applicationbrochure_January2010.pdf.

Name S-6

Executive Summary

Application S-6 received standard incentives from Illinois DCEO for installation of a high efficiency split HVAC system. The electric realization rate for this project is 184%, and the natural gas realization rate is 57%.

Project Description

The customer installed a new high efficiency split HVAC system. The installed split AC unit has an efficiency of 16 SEER. The installed furnace has an efficiency of 96.7% AFUE.

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified equipment had been installed and was operating. To verify the installed equipment, ADM field staff documented unit nameplates.

Standard Incentives

Energy savings were calculated according to the Illinois TRM Version 3.0 (errata-corrected).

For the furnace, TRM section 4.4.11 High Efficiency Furnace was used.

ELECTRIC ENERGY SAVINGS

$$\Delta \text{kWh} = \text{Heating Savings} + \text{Cooling Savings} + \text{Shoulder Season Savings}$$

Where:

Heating Savings = Brushless DC motor or Electronically commutated motor (ECM)
= 418 kWh

Cooling Savings = Brushless DC motor or electronically commutated motor (ECM)
If air conditioning
= 263 kWh

Shoulder Season Savings = Brushless DC motor or electronically commutated motor (ECM)
= 51 kWh

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta \text{kW} = (\Delta \text{kWh} / (\text{HOURS}_{\text{year}} * \text{Days}_{\text{Year}})) * \text{CF}$$

Where:

HOURS_{year} = Actual hours per year if known, otherwise use hours from Table

CF = Summer Peak Coincidence Factor

NATURAL GAS ENERGY SAVINGS

$$\Delta \text{Therms} = \text{EFLH} * \text{Capacity} * ((\text{AFUE}(\text{eff}) - \text{AFUE}(\text{exist})) / \text{AFUE}(\text{exist})) / 100,000 \text{ Btu/Therm}$$

Where:

EFLH	= Equivalent Full Load Hours for heating
Capacity	= Nominal Heating Capacity Furnace Size (btuh)
AFUE(exist)	= Existing Furnace Annual Fuel Utilization Efficiency Rating
AFUE(eff)	= Efficient Furnace Annual Fuel Utilization Efficiency Rating

For the AC, section 4.4.14 Single-Package and Split System Unitary Air Conditioners was used.

ELECTRIC ENERGY SAVINGS

For units with cooling capacities less than 65 kBtu/h:

$$\Delta \text{kWH} = (\text{kBtu/h}) * [(1/\text{SEER}_{\text{base}}) - (1/\text{SEER}_{\text{ee}})] * \text{EFLH}$$

For units with cooling capacities equal to or greater than 65 kBtu/h:

$$\Delta \text{kWH} = (\text{kBtu/h}) * [(1/\text{EER}_{\text{base}}) - (1/\text{EER}_{\text{ee}})] * \text{EFLH}$$

Where:

kBtu/h	= capacity of the cooling equipment actually installed in kBtu per hour (1 ton of cooling capacity equals 12 kBtu/h).
SEER _{base}	= Seasonal Energy Efficiency Ratio of the baseline equipment; see table
SEER _{ee}	= Seasonal Energy Efficiency Ratio of the energy efficient equipment (actually installed).
EER _{base}	= Energy Efficiency Ratio of the baseline equipment; see table above for default values. Since IECC 2006 does not provide EER requirements for air-cooled air conditioners < 65 kBtu/h, assume the following conversion from SEER to EER: $\text{EER} \approx \text{SEER}/1.1$
EER _{ee}	= Energy Efficiency Ratio of the energy efficient equipment. For air-cooled air conditioners < 65 kBtu/h, if the actual EER _{ee} is unknown, assume the following conversion from SEER to EER: $\text{EER} \approx \text{SEER}/1.1$. = Actual installed
EFLH	= cooling equivalent full load hours; see table

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta \text{kW}_{\text{SSP}} = (\text{kBtu/h} * (1/\text{EER}_{\text{base}} - 1/\text{EER}_{\text{ee}})) * \text{CF}_{\text{SSP}}$$

Where:

CF_{SSP}	= Summer System Peak Coincidence Factor for Commercial cooling (during system peak hour) = 91.3%
--------------------------	---

Measure-level Gross Savings Results

Standard Incentives

The tables shown below present the verified gross savings for measures that received standard incentives.

Annual kWh Savings for High Efficiency Split HVAC Unit

Measure	Program Type	Building Type	Equipment type	Subcategory or rating Condition	New Cooling Capacity (kbtu/h)	SEER of Efficient Equipment	Zone	Electric Resistance Heat?	Annual Gross kWh Savings	
									Ex Ante	TRM-Calculated Ex Post
Single-Package and Split System Unitary Air Conditioners	TOS	Lodging Hotel/Motel/Multifamily	Air conditioners, Air cooled	Split System	60	16	2 (Chicago)	No	816	1440.8
Total									816	1440.8

Annual Therms Savings for High Efficiency Furnace

Measure	Program Type	AC or No AC	AFUE of Efficient Equipment	Building Type	Zone	Furnace Capacity (BTUH)	Annual Gross Therms Savings		
							Ex Ante	TRM-Calculated Ex Post	TRM-Calculated (Errata Corrected) Ex Post
High Efficiency Furnace	TOS	Air Conditioning	96.7%	Lodging Hotel/Motel/Multifamily	2 (Chicago)	120,000	466.8	531	513.5
Total							466.8	531	513.5

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Electric Savings/Realization Rates

Incentive Type	Measure Category	Annual Gross Savings				Lifetime Gross Savings	
		Ex Ante kWh	Ex Post kWh	Realization Rate	Ex Post Peak kW Reduction	Ex Post kWh	Ex Post Peak kW Reduction
Standard	Single-Package and Split System Unitary Air Conditioners	816	1,440.8	177%	0.96	22,709	0.96
Total		816	1,440.8	177%	0.96	22,709	0.96

Verified Natural Gas Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>			<i>Lifetime Gross Savings</i>
		<i>Ex Ante Therms</i>	<i>Ex Post Therms</i>	<i>Realization Rate</i>	<i>Ex Post Therms</i>
Standard	High Efficiency Furnace	239	513.5	215%	8,473
Total		239	513.5	215%	8,473

The 177% verified electric realization rate is likely due to TRM Version 2.0 using a cooling EFLH of 252 for multifamily in Chicago. The ex ante prescriptive savings is 77 kWh per ton, and it is likely based on averages of building types, climate zones, baseline and as-built efficiencies.

The 215% verified natural gas realization rate is likely due to TRM Version 3.0 allowing an time-of-sale baseline efficiency of 80% resulting in savings higher than the ex ante. The ex ante uses 3.89 Therms per kBtuh. The assumptions and values used in the ex ante are unknown, so definitive conclusions cannot be made.

Name S-7

Executive Summary

Application S-7 received Standard incentives from Illinois-DCEO for retrofitting lighting in their facility. The realization rate for this project is 170%.

Project Description

The customer installed and retrofitted the following:

- (50) 4' 1LT8 fixtures with (10) 2x2 LED fixtures
- (46) 4' 2LT8 fixtures with (29) 2x2 LED fixtures
- Installation of Occupancy Sensors

Methodology for Estimating Gross Savings.

During the M&V visit, ADM staff verified equipment had been installed and was operating. To verify the installed equipment, ADM staff documented fixture quantities and interviewed the site contact to verify operating hours.

Standard Incentives

Energy savings were calculated according to the Illinois TRM Version 2.0.

For the lighting retrofit TRM sections 4.5.4 and 4.5.10 were used.

ELECTRIC ENERGY SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * Hours * WHF_e * ISR$$

Where:

$Watts_{base}$	= input wattage of the existing system
$Watts_{EE}$	= new input wattage of EE fixture
WHF_e	= waste heat factor to account for cooling energy savings
ISR	= In service rate = % of units rebated that get installed

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * WHF_d * CF * ISR$$

Where:

WHF_d	= waste heat factor to account for cooling demand savings
CF	= Summer Peak Coincidence Factor

For the lighting controls, TRM section 4.5.10 was used.

ELECTRIC ENERGY SAVINGS

$$\Delta kWh = kW_{controlled} * Hours * ESF * WHF_e$$

Where:

$kW_{controlled}$ = total lighting load connected to the control in kilowatts

ESF = Energy Savings Factor

WHF_e = waste heat factor to account for cooling energy savings

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kWh = kW_{controlled} * WHF_d * (CF_{baseline} - CF_{os})$$

Where:

WHF_d = heat factor to account for cooling demand savings

CF_{baseline} = Baseline Summer Peak Coincidence Factor

CF_{os} = Retrofit Summer Peak Coincidence Factor

Measure-level Gross Savings Results***Standard Incentives***

The table shown below presents the verified gross savings for measures that received standard incentives.

Annual kWh Savings for Lighting Retrofit

Measure					Annual Gross kWh Savings	
	Existing Wattage	Efficient Wattage	Hours	WHF _e	Ex Ante	TRM-Calculated Ex Post
RF - LED Bulbs and Fixtures	32	44.9	3540	1.14	1,788	4,645
RF - LED Bulbs and Fixtures	59	44.9	3540	1.14	2,190	5,698
Total					3,978	10,343

Annual kWh Savings for Lighting Controls

<i>Measure</i>					<i>Annual Gross kWh Savings</i>	
	<i>kW Controlled</i>	<i>Hours</i>	<i>ESF</i>	<i>WHFd</i>	<i>Ex Ante</i>	<i>TRM-Calculated Ex Post</i>
RF - Occupancy Sensor Lighting Controls	3,071	3540	0.41	1.5	5,088	5,081
Total					5,088	5,081

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Electric Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>				<i>Lifetime Gross Savings</i>
		<i>Ex Ante kWh</i>	<i>Ex Post kWh</i>	<i>Realization Rate</i>	<i>Ex Post Peak kW Reduction</i>	<i>Ex Post kWh</i>
Standard	LED Bulbs and Fixtures	3,978	10,343	260%	2.15	102,260
Standard	Occupancy Controls	5,088	5,081	100%	1.06	142,911
Total		9,066	15,424	170%	3.21	245,171

The project level realization rate is 170%. For the lighting retrofit the realization rate is high because the ex ante savings estimate applied a savings of 2.15 kWh per connected watt reduced (ranging from 75.52 kWh to 178.80 kWh per fixture), whereas the ex post analysis used the TRM savings calculation per fixture ranging from 196.48 kWh to 464.50 kWh. For the occupancy sensors the ex ante estimate was highly accurate.

Name S-8

Executive Summary

Application S-8 received standard incentives from Illinois DCEO for retrofitting lighting and installing low flow faucet aerators in their facility. The electric realization rate is 125%, and the natural gas realization rate is 149%.

Project Description

The customer retrofitted and installed the following fixtures:

A Building:

- (174) 4'T12 lamps were removed
- (3) 4' 1LT12 lamps with (3) 4' 1LT8 lamps
- (1) 4' 2LT12 lamps with (1) 4' 2LT8 lamps
- (87) 4' 2LT12 lamps with (87) 4' 2LT8 lamps
- (2) 100w Incandescent lamps with (2) 19w LED lamps in the exterior area
- (6) 60w Incandescent lamps with (6) 9w LED lamps
- (2) 60w Incandescent lamps with (2) 19w LED lamps in the exterior area
- (5) 75w Incandescent lamps with (5) 9w LED lamps
- (4) 60w Incandescent lamps with (4) 9w LED lamps
- (6) Incandescent exit signs with (6) LED exit signs

B Building:

- (6) 4' 2LT12 lamps with (6) 4' 2LT8 lamps
- (1) 4' 2LT12 lamps with (1) 4' 2LT8 lamps
- (2) 60w Incandescent lamps with (2) 9w LED lamps
- (1) 75w Incandescent lamp with (1) 9w LED lamp
- (3) 45w Incandescent lamps with (3) 19w LED lamps in the exterior
- (2) 90w Incandescent lamps with (2) 19w LED lamps in the exterior
- (4) Incandescent exit signs with (4) LED exit signs
- (12) T12 lamps removed
- (2) Halogen wall packs with (2) LED wall packs in the exterior
- (1) 458w Metal Halide lamp with (1) 92w LED lamp in the exterior
- (2) 150w Halogen lamps with (2) 18w LED lamps in the exterior

The customer also installed (4) low flow faucet aerators in restrooms.

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified that the low flow faucet aerators were installed. ADM staff documented fixture quantities and interviewed the site contact to verify operating hours.

Standard Incentives

Energy savings were calculated according to the Illinois TRM Version 2.0.

For the lighting retrofit TRM sections 4.5.2, 4.5.3, 4.5.4, 4.5.5 were used.

ELECTRIC ENERGY SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * Hours * WHF_e * ISR$$

Where:

Watts _{base}	= input wattage of the existing system
Watts _{EE}	= new input wattage of EE fixture
WHF _e	= waste heat factor to account for cooling energy savings
ISR	= In service rate = % of units rebated that get installed

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * WHF_d * CF * ISR$$

Where:

WHF _d	= waste heat factor to account for cooling demand savings
CF	= Summer Peak Coincidence Factor

ADM estimated energy savings according to the errata corrected Illinois TRM Version 3.0, Section 4.3.2 Low Flow Faucet Aerators.

NATURAL GAS ENERGY SAVINGS

$$\Delta \text{Therms} = \%FossilDHW * ((GPM_{base} - GPM_{low}) / GPM_{base}) * Usage * EPG_{gas} * ISR$$

Where:

%FossilDHW	= proportion of water heating supplied by fossil fuel heating = 100%
GPM _{base}	= Average flow rate, in gallons per minute, of the baseline faucet “as-used” = 1.39 or custom based on metering studies
GPM _{low}	= Average flow rate, in gallons per minute, of the low-flow faucet aerator “as-used” = 0.94 or custom based on metering studies
Usage	= Estimated usage of mixed water (mixture of hot water from water heater line and cold water line) per faucet (gallons per year)
EPG _{gas}	= Energy per gallon of mixed water used by faucet (gas water heater) = (8.33 * 1.0 * (WaterTemp - SupplyTemp)) / (RE _{gas} * 100,000)

$$= 0.00446 \text{ Therm/gal}$$

Where:

RE_{gas} = Recovery efficiency of gas water heater

= 67%

100,000 = Converts Btus to Therms (Btu/Therm)

ISR = In service rate = deemed value based on direct install = 95%

Measure-level Gross Savings Results

Standard Incentives

The tables shown below present the verified gross savings for measures that received standard incentives.

Annual kWh Savings for Lighting Retrofit

Measure					Annual Gross kWh Savings	
	Existing Wattage	Efficient Wattage	Hours	WHFe	Ex Ante	TRM-Calculated Ex Post
A Bldg.						
RF- Fluorescent Delamping	33.7	0	4439	1.25	29,737	32,537
RF- High Performance and Reduced Wattage T8 Fixtures and Lamps	46	25	4439	1.25	15,732	350
RF- High Performance and Reduced Wattage T8 Fixtures and Lamps	92	49	4439	1.25	-	239
RF- High Performance and Reduced Wattage T8 Fixtures and Lamps	92	49	4439	1.25	-	20,758
TOS/NC/RF – LED Screw Bulbs	90	18.75	4903	1	2,242	699
TOS/NC/RF – LED Screw Bulbs	65	9	3088	1.25	-	1,297
TOS/NC/RF – LED Screw Bulbs	65	18.75	4903	1	-	454
TOS/NC/RF – LED Screw Bulbs	75	9	3088	1.25	-	1,274
TOS/NC/RF – LED Screw Bulbs	60	9	3088	1.25	-	787
RF- Commercial LED	35	2	8766	1.25	1,381	2,170

Measure					Annual Gross kWh Savings	
	Existing Wattage	Efficient Wattage	Hours	WHFe	Ex Ante	TRM-Calculated Ex Post
Exit Sign						
B Building						
RF- High Performance and Reduced Wattage T8 Fixtures and Lamps	92	49	4439	1.25	1,230	1,432
RF- High Performance and Reduced Wattage T8 Fixtures and Lamps	92	49	4439	1.25	-	239
TOS/NC/RF – LED Screw Bulbs	60	9	3088	1.25	854	394
TOS/NC/RF – LED Screw Bulbs	75	9	3088	1.25	-	255
TOS/NC/RF – LED Screw Bulbs	45	18.75	4903	1	-	386
TOS/NC/RF – LED Screw Bulbs	90	18.75	4903	1		699
RF- Commercial LED Exit Sign	35	2	8766	1.25	920	1,446
RF- Fluorescent Delamping	33.7	0	4439	1.25	2,051	2,244
TOS/NC/RF – LED Bulbs and Fixtures	150	26	4903	1	492	1,216
TOS/NC/RF – LED Bulbs and Fixtures	458	92	4903	1	1,156	1,794
TOS/NC/RF – LED Bulbs and Fixtures	150	18	4903	1	1,603	1,294
Total					57,400	71,962

Annual Therms Savings for Low Flow Faucet Aerators

Measure	Quantity	Building Type	Annual Gross Therms Savings		
			Ex Ante	TRM-Calculated Ex Post	TRM-Calculated (Errata Corrected) Ex Post
Low Flow Faucet Aerators	3	Small Office	6.9	6.9	10.3
Low Flow Faucet Aerators	1	Small Office	2.3	2.3	3.4
Total			9.2	9.2	13.7

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Electric Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>				<i>Lifetime Gross Savings</i>
		<i>Ex Ante kWh</i>	<i>Ex Post kWh</i>	<i>Realization Rate</i>	<i>Ex Post Peak kW Reduction</i>	<i>Ex Post kWh</i>
Standard	Fluorescent Delamping	31,787	34,781	109%	5.38	382,587
	T8 Fixtures and Lamps	16,963	23,016	136%	3.56	130,147
	LED Bulbs and Fixtures	6,348	10,549	208%	0.89	65,834
	LED Exit Signs	2,301	3,616	157%	0.28	57,856
Total		57,400	71,962	125%	10.11	662,434

Verified Natural Gas Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>			<i>Lifetime Gross Savings</i>
		<i>Ex Ante Therms</i>	<i>Ex Post Therms</i>	<i>Realization Rate</i>	<i>Ex Post Therms</i>
Standard	Low Flow Faucet Aerators	9.2	13.7	149%	123.5
Total		9.2	13.7	149%	123.5

The electric realization rate is 125%. The ex ante estimate for the Fluorescent Delamping provides 171 kWh per lamp removed while the ex post savings analysis utilized the TRM calculation of 187 kWh per lamp removed. For High Performance T8 lamps the ex ante used 88 kWh per fixture while the TRM savings ranged from 117 kWh to 239 kWh per fixture. The ex ante savings for LED lamps and fixtures ranged from 107 kWh to 246 kWh per lamp/fixture while the TRM savings ranged from 349 kWh to 608 kWh. In addition, for Commercial LED exit signs the ex ante savings estimate used 230 kWh while the ex post utilized the TRM savings of 362 kWh per sign.

The ex ante natural gas savings estimates are calculated using the Illinois TRM Version 2.0. The ex post analysis used Version 3.0 since this is an errata measure. Version 3.0 increases the baseline flow from 1.2 gpm to 1.39 gpm. Thus, the natural gas realization rate is 149%.

Name S-9

Executive Summary

Application S-9 received standard incentives from Illinois DCEO for installation of lighting throughout its facility. The electric realization rate for this project is 148%.

Project Description

The customer installed (12) LED wall packs, (270) high performance 4 foot T8 lamps, LED fixtures with a connected watt reduction of 7,176 watts, and T8 high bay fluorescent fixtures with a connected watt reduction of 1,734 watts.

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified the equipment had been installed and was operating. To verify the installed equipment, ADM field staff documented installed equipment quantities and wattages.

Standard Incentives

For the lighting retrofit, energy savings were calculated according to the TRM Version 2.0, Section 4.5 Lighting End Use.

ELECTRIC ENERGY SAVINGS

$$\Delta kWh = ((Watts_{base} - Watts_{EE}) / 1000) * Hours * WHF_e * ISR$$

Where:

Watts _{base}	= Input wattage of the existing system.
Watts _{EE}	= New Input wattage of EE fixture.
Hours	= Average hours of use per year are provided in the Reference Table in Section 4.5, Screw based bulb annual operating hours, for each building type. If unknown, use the Miscellaneous value.
WHF _e	= Waste heat factor for energy to account for cooling energy savings from efficient lighting are provided below for each building type in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.
ISR	= In service Rate - the percentage of units rebated that actually get installed. Use 100% unless an evaluation shows a lesser value

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kW = ((Watts_{base} - Watts_{EE}) / 1000) * ISR * WHF_d * CF$$

Where:

WHF _d	= Waste Heat Factor for Demand to account for cooling savings from efficient lighting in cooled buildings is provided in Reference Table in Section 4.5. If unknown, use the miscellaneous value.
------------------	---

CF = Summer Peak Coincidence Factor for measure is provided in the Reference Table in Section 4.5. If unknown, use the miscellaneous value

Measure-level Gross Savings Results

Standard Incentives

The tables shown below present the verified gross savings for measures that received standard incentives.

Annual kWh Savings for Lighting

<i>Measure</i>	<i>Annual Gross kWh Savings</i>					
	<i>Existing Wattage</i>	<i>Efficient Wattage</i>	<i>Hours</i>	<i>WHFe</i>	<i>Ex Ante</i>	<i>TRM-Calculated Ex Post</i>
LED	78	52.5	3,540	1.00	6,114	25,371
LED	458	52.5	4,903	1.00	12,780	23,858
T8	94	72	3,540	1.00	9,195	2,053
T8	59	25	4,311	1.23		8,473
T8	88	72	4,311	1.23	6,872	848
T8	114	94	4,311	1.23		1,590
T8	59	49	4,311	1.23		4,772
LED	78	52.5	3,540	1.00		25,371
Total					34,961	66,967

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Electric Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>				<i>Lifetime Gross Savings</i>
		<i>Ex Ante kWh</i>	<i>Ex Post kWh</i>	<i>Realization Rate</i>	<i>Ex Post Peak kW Reduction</i>	<i>Ex Post kWh</i>
Standard	Lighting	34,961	66,967	148%	8.23	668,008
Total		34,961	66,967	148%	8.23	668,008

The verified electric realization rate is 192%, which is due to several factors.

For the LED Wall Packs, the ex ante savings estimation applies savings of 1,883 kWh per fixture in a school, whereas the TRM calculations result in savings of 1,988 kWh per fixture.

For the new interior LEDs, the ex ante savings estimation applies savings of 2.15 kWh per connected watt reduced (equaling savings of 857.1 kWh per fixture), whereas the TRM calculations result in savings per fixture of 1,409.5 kWh. The difference is mainly due to a large number of baseline fixtures that are unaccounted for in the ex ante savings estimation.

For the T8 high bay fixtures, savings of 2.15 kWh per connected watt reduced are applied in the ex ante savings estimation (equaling savings of 71.7 kWh per fixture), but the TRM calculations result in savings of 202.4 kWh per fixture. The high realization is due to the difference between TRM assumptions of baseline and as-built fixture wattages versus ex ante baseline and as-built fixture wattages.

For the reduced wattage 4 foot T8 lamps, the ex ante savings estimation applies savings of 12.6 kWh per lamp, but the TRM calculations result in savings of 26.7 kWh per lamp. The ex ante assumptions are unknown, so definitive conclusions cannot be made.

Name S-10

Executive Summary

Application S-10 received standard incentives from Illinois DCEO for installation of Demand Control Ventilation (DCV) on air handling units serving 31,000 ft² of space. The natural gas realization rate is 21%.

Project Description

The customer installed DCV sensors to control the minimum outside air being supplied to conditioned spaces by the two primary air handling units. Originally minimum outside air was being supplied to spaces regardless of occupancy; with the addition of DCV the volume of outside air being supplied to spaces is dependent upon the percent of CO₂ gas present in the space.

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified equipment had been installed and was operating.

Standard Incentives

Energy savings were calculated according to the Illinois TRM Version 3.0. Since a calculation methodology was not available in the Illinois TRM Version 2.0, ADM opted to use the provided calculation in the Illinois TRM Version 3.0.

For the DCV controls, TRM Section 4.4.19 Demand Control Ventilation was used.

NATURAL GAS ENERGY SAVINGS

$$\Delta Therms = \frac{SqFt}{1000} * SF$$

Where:

SqFt = Actual square footage of conditioned spaced controlled

SF = Therms savings factor based on building type and weather zone

ELECTRIC ENERGY SAVINGS

$$\Delta kWh = \frac{SqFt}{1000} * SF$$

Where:

SqFt = Actual square footage of conditioned spaced controlled

SF = kWh savings factor based on building type and weather zone

Measure-level Gross Savings Results

Standard Incentives

The tables shown below present the verified gross savings for measures that received standard incentives.

Annual kWh Savings for DCV Controls

Measure					Annual Gross kWh Savings	
	Program Type	Building Type	Zone	Conditioned Space (Sq. Ft.)	Ex Ante	ADM Calculated Ex Post
DCV	RF	Default	2 (Chicago)	31,000	0	18,879
Total					0	18,879

Annual Therms Savings for DCV Controls

Measure					Annual Gross Therm Savings	
	Program Type	Building Type	Zone	Conditioned Space (Sq. Ft.)	Ex Ante	ADM Calculated Ex Post
DCV	RF	Default	2 (Chicago)	31,000	9,920	2,108
Total					9,920	2,108

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Electric Savings/Realization Rates

Incentive Type	Measure Category	Annual Gross Savings				Lifetime Gross Savings	
		Ex Ante kWh	Ex Post kWh	Realization Rate	Ex Post Peak kW Reduction	Ex Post kWh	Ex Post Peak kW Reduction
Standard	DCV	-	18,879	N/A	-	188,790	-
Total		-	18,879		-	188,790	-

Verified Natural Gas Savings/Realization Rates

<i>Incentive Type</i>	<i>Measure Category</i>	<i>Annual Gross Savings</i>			<i>Lifetime Gross Savings</i>
		<i>Ex Ante Therms</i>	<i>Ex Post Therms</i>	<i>Realization Rate</i>	<i>Ex Post Therms</i>
Standard	DCV	9,920	2,108	21%	21,080
Total		9,920	2,108	21%	21,080

The ex-ante project application failed to claim electrical savings for the installation of DCV. The reported savings by ADM are based upon the calculation methodology reported in the IL TRM Version 3.0.

ADM is unable to fully explain the savings documented in the project application. This is due to ex-ante calculations not being provided as part of the project documentation packet. The verified natural gas savings results in a realization rate of 21%.

Name S-11, C-3

Executive Summary

Application S-11, C-3 received standard and custom incentives from Illinois DCEO for installing natural gas furnaces, natural gas boilers, unitary AC units, and demand control ventilation in their facility. The natural gas realization rate is 71%, and the electric realization rate is 46%.

Project Description

The participant installed (3) 80 MBH Lochinvar boilers, (3) 78,000 Btu Carrier furnaces, (1) 7.5 Ton Carrier package A/C unit, (1) 3 Ton Carrier package A/C unit to replace, (17) 3 Ton Carrier split A/C units, and (3) 4 Ton Carrier package A/C units. The facility also installed demand control ventilation sensors and controls on HVAC units serving 20 rooms. The new controls are designed to regulate the amount of outside air being supplied, dependent upon the occupancy levels within the classroom. This results in energy savings by reducing the amount of unnecessary outdoor air at any given time while reducing load on the HVAC system.

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified that the equipment was installed and operational and documented equipment nameplate information.

Standard Incentives

NATURAL GAS ENERGY SAVINGS

ADM estimated energy savings according to the Errata Corrected Illinois TRM Version 3.0, Section 4.4.10 High Efficiency Boiler.

$$\Delta Therm = \frac{EFLH * Capacity * \left(\frac{Eff_{efficient} - EFF_{base}}{Eff_{base}} \right)}{100,000}$$

Where:

EFLH	= Equivalent Full Load Hours for heating (see table)
Capacity	= Nominal Heating Capacity Boiler Size (btuh) = custom Boiler input capacity in Btu/hr
EFFefficient	= Baseline Boiler Efficiency Rating, dependent on year and boiler type. Baseline efficiency values by boiler type and capacity are found in the Definition of Baseline Equipment Section
EFFbase	= Efficient Boiler Efficiency Rating use actual value

ADM estimated energy savings according to the Errata Corrected Illinois TRM Version 3.0, Section 4.4.11 High Efficiency Furnace, which provided the following equation:

$$\Delta Therm = \frac{EFLH * Capacity * \left(\frac{AFUE_{efficient} - AFUE_{base}}{AFUE_{base}} \right)}{100,000}$$

Where:

EFLH	= Equivalent Full Load Hours for heating
Capacity	= Nominal Heating Capacity Furnace Size (btuh)
AFUE(base)	= Existing Furnace Annual Fuel Utilization Efficiency Rating
AFUE(efficient)	= Efficient Furnace Annual Fuel Utilization Efficiency Rating

ELECTRIC ENERGY SAVINGS

ADM estimated energy savings resulting from the new furnaces using the Illinois TRM Version 3.0, Section 4.4.11 provided the following formula for electric energy savings:

$$\Delta kWh = Heating + Cooling + Shoulder Season$$

Where:

$$Heating = 418kWh$$

$$Cooling = \text{Deemed Savings in TRM}$$

$$Shoulder Season = 51kWh$$

ADM estimated energy savings resulting from the new unitary air conditioners using the Illinois TRM Version 2.0, Section 4.4.14 provided the following formula for electric energy savings:

For units with cooling capacities less than 65 kBtu/h:

$$\Delta kWh = (kBtu/h) * [(1/SEER_{base}) - (1/SEER_{ee})] * EFLH$$

For units with cooling capacities equal to or greater than 65 kBtu/h:

$$\Delta kWh = (kBtu/h) * [(1/EER_{base}) - (1/EER_{ee})] * EFLH$$

Where:

kBtu/h	= capacity of the cooling equipment actually installed in kBtu per hour (1 ton of cooling capacity equals 12 kBtu/h).
SEER _{base}	= Seasonal Energy Efficiency Ratio of the baseline equipment; see table
SEER _{ee}	= Seasonal Energy Efficiency Ratio of the energy efficient equipment (actually installed).
EER _{base}	= Energy Efficiency Ratio of the baseline equipment; see table above for default values. Since IECC 2006 does not provide EER requirements for air-cooled air conditioners < 65 kBtu/h, assume the following conversion from SEER to EER: $EER \approx SEER/1.1$
EER _{ee}	= Energy Efficiency Ratio of the energy efficient equipment. For air-cooled air conditioners < 65 kBtu/h, if the actual EER _{ee} is unknown, assume the following conversion from SEER to EER: $EER \approx SEER/1.1$.
	= Actual installed
EFLH	= cooling equivalent full load hours; see table

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kW_{SSP} = (kBtu/h * (1/EER_{base} - 1/EER_{ee})) * CF_{SSP}$$

Where:

$$CF_{SSP} = \text{Summer System Peak Coincidence Factor for Commercial cooling (during system peak hour)}$$

$$= 91.3\%$$

Custom Incentives**NATURAL GAS ENERGY SAVINGS**

ADM estimated energy savings according to the Illinois TRM Version 3.0, Section 4.4.19 Demand Control Ventilation.

$$\Delta Therms = \frac{SqFt}{1000} * SF$$

Where:

SqFt = Actual square footage of conditioned spaced controlled

SF = Therms savings factor based on building type and weather zone

ELECTRIC ENERGY SAVINGS

ADM estimated energy savings according to the Illinois TRM Version 3.0, Section 4.4.19 Demand Control Ventilation.

$$\Delta kWh = \frac{SqFt}{1000} * SF$$

Where:

SqFt = Actual square footage of conditioned spaced controlled

SF = kWh savings factor based on building type and weather zone

Measure-level Gross Savings Results**Standard Incentives**

The tables shown below present the verified gross savings for measures that received standard incentives

Annual Therms Savings for High Efficiency Boilers

Measure	Measure Metrics							Annual Gross Therms Savings		
	Program Type	Qty	Boiler btuh	Base Boiler type	Boiler Efficiency	Zone	Building Type	Ex Ante	TRM-Calculated	TRM-Calculated (Errata Corrected)
								Ex Post	Ex Post	Ex Post
High Efficiency Boiler	TOS	3	800,000	Hot Water ≥300,000 & ≤2,500,000 Btu/h	92.5%	3 (Springfield)	Elementary	2,520	3,758	3,476
Total								2,520	3,758	3,476

Annual Therms Savings for High Efficiency Furnaces

Measure	Measure Metrics							Annual Gross Therms Savings		
	Program Type	Qty	AC or No AC	Efficient Measure	Building Type	Zone	Furnace Capacity (BTUH)	Ex Ante	TRM-Calculated	TRM-Calculated (Errata Corrected)
								Ex Post	Ex Post	Ex Post
High Eff. Furnace	TOS	3	Air Conditioning	92.1%	Elementary	3 (Springfield)	78,000	312	356	328
Total								312	356	328

Annual kWh Savings for High Efficiency Furnaces

Measure	Measure Metrics							Annual Gross kWh Savings		
	Program Type	Qty	AC or No AC	Efficient Measure	Building Type	Zone	Furnace Capacity (BTUH)	Ex Ante	TRM-Calculated	TRM-Calculated (Errata Corrected)
								Ex Post	Ex Post	Ex Post
High Eff. Furnace	TOS	3	Air Conditioning	92.1%	Elementary	3 (Springfield)	78,000	1,107	2,196	2,196
Total								1,107	2,196	2,196

Annual kWh Savings for High Efficiency Unitary AC

Measure	Measure Metrics								Annual Gross kWh Savings	
	Program Type	Equipment type	Subcategory or rating Condition	Qty	New Cooling Capacity (kbtu/h)	SEER of Efficient Equipment	Zone	Electric Resistance Heat?	Ex Ante	TRM-Calculated
										Ex Post
Single-Package and Split System Unitary Air Conditioners	TOS	Air conditioners, Air cooled	Single Package	1	89.0	13.2	3 (Springfield)	FALSE	372	675
Single-Package and Split System Unitary Air Conditioners	TOS	Air conditioners, Air cooled	Single Package	1	36.0	15	3 (Springfield)	FALSE	149	172
Single-Package and Split System Unitary Air Conditioners	TOS	Air conditioners, Air cooled	Split System	17	34.4	14.5	3 (Springfield)	FALSE	2,532	4,658
Single-Package and Split System Unitary Air Conditioners	TOS	Air conditioners, Air cooled	Split System	3	46.0	14.5	3 (Springfield)	FALSE	596	1,099
Total									3,649	6,604

Custom Incentives

The tables shown below present the verified gross savings for measures that received custom incentives.

Annual Therms Savings for DCV

Measure	Measure Metrics				Annual Gross Therms Savings	
	Program Type	Building Type	Zone	Conditioned Space (Sq. Ft.)	Ex Ante	ADM Calculated
						Ex Post
DCV	TOS	Elementary	3 (Springfield)	18,000	3,966	1,008
Total					3,966	1,008

Annual kWh Savings for DCV

Measure	Measure Metrics				Annual Gross kWh Savings	
	Program Type	Building Type	Zone	Conditioned Space (Sq. Ft.)	Ex Ante	ADM Calculated Ex Post
DCV	TOS	Elementary	3 (Springfield)	18,000	41,114	12,096
Total					41,114	12,096

Project-level Gross Savings Results

The tables shown below present the verified gross savings for this project.

Verified Natural Gas Savings/Realization Rates

Incentive Type	Measure Category	Annual Gross Savings			Lifetime Gross Savings
		Ex Ante Therms	Ex Post Therms	Realization Rate	Ex Post Therms
Standard	High Eff. Boiler	2,520	3,476	138%	69,525
	High Eff. Furnace	312	328	105%	16,246
<i>Subtotal</i>		2,832	3,804	134%	85,771
Custom	DCV	3,966	1,008	25%	10,080
<i>Subtotal</i>		3,966	1,008	25%	10,080
Total		6,798	4,812	71%	95,851

Verified Electric Savings/Realization Rates

Incentive Type	Measure Category	Annual Gross Savings				Lifetime Gross Savings	
		Ex Ante kWh	Ex Post kWh	Realization Rate	Ex Post Peak kW Reduction	Ex Post kWh	Ex Post Peak kW Reduction
Standard	High Eff. Furnace	1,107	2,196	198%	2.39	36,234	2.39
	High Eff. HVAC	3,649	6,604	181%	6.56	99,060	6.56
<i>Subtotal</i>		4,756	8,800	185%	8.96	135,294	8.96
Custom	DCV	41,114	12,096	29%	0.00	120,960	0.00
<i>Subtotal</i>		41,114	12,096	29%	0.00	120,960	0.00
Total		45,870	20,896	46%	8.96	256,254	8.96

The overall 71% gas and 46% electric realization rates can be attributed to an overestimation in the DCV savings in the ex-ante calculations. By reviewing the submitted calculations, it appears

that the calculations failed to include heating and cooling system efficiencies. The reported ex-ante savings are actually the thermal energy saved not the electrical or gas energy savings.

Name S-12

Executive Summary

Application S-12 received standard incentives from Illinois DCEO for installation of high efficiency spray valves and electronically commutated motors (EC Motors, ECMs). The electric realization rate for this project is 126%, and the natural gas realization rate is 115%.

Project Description

The customer retrofitted the following:

Building A

- (2) 4' 4LT12 lamps with (2) 4' 2LT8 lamps
- Permanent removal of (4) T12 lamps
- (1) Incandescent Exit Sign with (1) LED Exit Sign
- (5) MH 1,150w Pole Lamps with (5) LED 169w Pole Lamps
- (6) MH 285w Pole Lamps with (6) LED 85w Pole Lamps
- (3) MH 201w Pole Lamps with (3) LED 85w Pole Lamps

Building B

- (4) MH 201w lamps with (4) LED 85w lamps
- (2) MH 285w Pole Lamp with (2) LED 85w Pole Lamp
- (5) MH 115w Lamps with (5) LED 43w Lamps
- (9) MV 285w Lamps with (9) LED 20w Lamps
- (4) high efficiency spray valves
- (6) EC motors – (2) in the walk-in freezer, (4) in the walk-in cooler

Methodology for Estimating Gross Savings

During the M&V visit, ADM staff verified equipment had been installed and was operating. ADM staff documented fixture quantities and interviewed the site contact to verify operating hours.

Standard Incentives

Energy savings were calculated according to the Illinois TRM Version 2.0.

For the lighting retrofit TRM sections 4.5.2, 4.5.3, 4.5.4, and 4.5.5 were used.

ELECTRIC ENERGY SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * Hours * WHF_e * ISR$$

Where:

$Watts_{base}$ = input wattage of the existing system

$Watts_{EE}$	= new input wattage of EE fixture
WHF_e	= waste heat factor to account for cooling energy savings
ISR	= In service rate = % of units rebated that get installed

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kWh = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * WHF_d * CF * ISR$$

Where:

WHF_d	= waste heat factor to account for cooling demand savings
CF	= Summer Peak Coincidence Factor

For the spray valves, TRM Section 4.2.11 High Efficiency Pre-Rinse Spray Valve was used.

NATURAL GAS ENERGY SAVINGS

$$\Delta \text{Therms} = \Delta \text{Gallons} \times 8.33 \times 1 \times (T_{out} - T_{in}) \times (1/EFF) / 100,000 \text{ Btu}$$

Where:

$\Delta \text{Gallons}$	= amount of water saved as calculated below Capacity = Nominal Heating Capacity Furnace Size (btuh) $= (FLO_{base} - FLO_{eff}) \text{ gal/min} \times 60 \text{ min/hr} \times \text{HOURS}_{day} \times \text{DAYS}_{year}$
FLO_{base}	= Base case flow in gallons per minute, or custom
FLO_{eff}	= Efficient case flow in gallons per minute or custom
HOURS_{day}	= Hours per day that the pre-rinse spray valve is used at the site, custom, otherwise see table
DAYS_{year}	= Days per year pre-rinse spray valve is used at the site, custom, otherwise 312 days/yr based on assumed 6 days/wk x 52 wk/yr = 312 day/yr.
8.33 lbm/gal	= specific mass in pounds of one gallon of water
1 Btu/lbm°F	= Specific heat of water: 1 Btu/lbm/°F
T_{out}	= Water Heater Outlet Water Temperature = custom, otherwise assume $T_{in} + 70^\circ \text{ F}$ temperature rise from T_{in}
T_{in}	= Inlet Water Temperature = custom, otherwise assume 54.1 degree F
EFF	= Efficiency of electric water heater supplying hot water to pre-rinse spray valve = custom, otherwise assume 97%

For the ECMs, TRM Section 4.6.4 Electronically Commutated Motors (ECM) for Walk-in and Reach-in Coolers / Freezers was used.

CALCULATION OF SAVINGS

Savings values are obtained from the SCE workpaper for efficient evaporator fan motors, which covers all 16 California climate zones. SCE savings values were determined using a set of assumed conditions for restaurants and grocery stores. We have used only PG&E climate zones in calculating our averages and have taken out the drier, warmer climates of southern California. SCE's savings approach calculates refrigeration demand, by taking into consideration temperature, compressor efficiency, and various loads involved for both walk-in and reach-in refrigerators. Details on cooling load calculations, including refrigeration conditions, can be found in the SCE workpaper. The baseline for this measure assumes that the refrigeration unit has a shaded-pole motor.

The tables are values calculated within the SCE workpaper and are presented in the TRM. Relevant table shown below:

	Restaurant			
SCE Workpaper Values	Cooler		Freezer	
Northern California Climate Zones	kWh Savings Per Motor	Peak kW Savings Per Motor	kWh Savings Per Motor	Peak kW Savings Per Motor
1	318	0.0286	507	0.03
2	253	0.033	263	0.037
3	364	0.0315	649	0.034
4	365	0.0313	652	0.034
5	350	0.0305	605	0.033
11	410	0.0351	780	0.04
12	399	0.034	748	0.039
13	407	0.0342	771	0.039
16	354	0.0315	620	0.034
Average	358	0.0322	622	0.036

Measure-level Gross Savings Results

Standard Incentives

The tables shown below present the verified gross savings for measures that received standard incentives.